CHAPTER 5

PUMPING STATION LAYOUTS

5-1. General. Pumps, piping, and equipment must be protected from the weather as dictated by local climatic conditions. In cold climates pumps and piping must be protected from freezing and are usually completely housed in structures. In warm climates portions of stations may be located in outside enclosures which must provide protection from moisture and other weather related conditions. The impact of noise on the surrounding area and the need for security fencing will be considered for all stations. Structures will be fire-resistive construction, usually of reinforced concrete, steel, and masonry wall construction. Standard windows for unattended remote located stations may be deleted for security reasons, if other provisions such as skylights or high windows are made for natural lighting or if artificial lighting is provided to assist periodic maintenance. The pumping equipment must be located so as not to be subject to flooding. The site will be graded to drain surface water away from structures. Roadway access for maintenance vehicles will be provided at all equipment locations with space provided for vehicle turn around. Buildings will be designed in compliance with local codes and regulations. Building layouts must be designed logically considering the sequence of installation of initial and future equipment if future expansion is planned. Space will be provided for removing equipment for repair without interrupting other equipment. Equipment layouts must provide vertical and horizontal clearances and access openings for maintenance and repair operations. Usually, main aisles will be four feet minimum. Work place safety of operating and maintenance personnel and security of the facility will be considered in the overall pump station design.

5-2. Structural Systems. The foundation design will be based upon a soils analysis and recommendations of a geotechnical engineer experienced in the field of soils mechanics and foundation design. Information on ground water conditions and the classification of soil types will be obtained through borings at the pump station location. For below grade structures the soils survey will be performed during the time of year when ground water is at its highest. Conditions to be considered in the design will be not only soil bearing qualities, but also soil swell potential and ground water infiltration into the structure through the lowest point of entry which will be either a pipe penetration or a joint in the concrete. Usually ground water should be at least one foot below the lowest point of entry. The structural design layout will show design of pipe anchors and pipe supports under pump operating conditions, and foundations under heavy equipment. Structural steel will be provided to support piping and conduit. Reinforced concrete bases raised above the floor will be provided for pumps, engine drives, large meters, large valves and control devices, and floor mounted electric equipment. Centrifugal pumps and driver will have common foundation and base plate. Refer to TM 5-805-4 for noise and vibration control for equipment installations. Floors will slope to floor drains located around all pumps. Floor loading will consider moving large equipment in and out for repair, maintenance, and replacement. Crane rails and traveling overhead hoists will be provided in large pump station buildings where use of temporary or portable hoisting equipment is not practical for maintenance, repair, and equipment removal operations. Sufficient headroom must be provided to allow equipment being removed to clear other equipment. A removable hatch, hinged hatch, or removable roof panel may be considered for removal of vertical long stem equipment. Split floor levels will be avoided where possible. Where different floor levels are necessary, standard stair design will be used and safety railing provided in accordance with OSHA standards.

5-3. Mechanical Equipment. Equipment layout will provide space for safe maintenance and operation of equipment. A typical pumping piping layout of a main pump station is shown in figure 5-1. Valves, meters, gauges and control devices will be located to be accessible without use of ladders, or use of chain wheels. Floors, gratings, and plates will be nonslip. Floor drains and pump gland drains will be provided in pump areas. Below grade equipment structures which cannot be drained by gravity piping will be provided with sump pumps. Engines may be located in separate buildings or in outdoor enclosures in warmer climates. Engines will be provided with adequate combustion air. Engines will have a cooling system, fueling system, lubrication system, electric starting system with battery charging, safety controls, and instrument and control panel as required for system operation. Fuel tanks will be located above ground where

possible with fuel spill protection and containment. Exhaust system with mufflers will be provided for engine exhaust. The noise level of running engines and impact on surrounding occupancies will be considered in locating engines and direction of exhaust stack. Extinguishers for fire protection will be provided. Safety guards will be provided on moving and rotating parts of all equipment. Storage facilities for equipment parts and tools for equipment maintenance will be provided.
Refer to Figure 5-2 for typical sections through a pump station.

5-4. Electrical. Switchgear, electrical panels, instrument panels and other controls will be located where convenient to operation personnel, where good visibility is provided, and away from possible floor flooding. Maintenance and operating space will be provided for all electrical gear. Generally, natural lighting at major pumping units and electrical pump control equipment will be provided. Artificial lighting with average 30 foot candle in main pump room will be provided. Additional localized lighting will serve instruments, control panels, gauges, and other devices routinely used to control pump station operation. Exterior lighting at doors, at exposed pump station control devices, and for area security will be provided. Convenience outlets will be provided for use by maintenance personnel. Emergency lights with battery power backup will be provided at critical control devices. Motor control systems with hand-off-automatic switches and motor protection devices for pump motors will be provided. Enclosures will be NEMA enclosure types to suit location.

5-5. Building Environmental Systems. Heating will be provided to prevent damage to equipment by condensation and to provide comfort conditions for operating personnel. Air conditioning will be provided in climates where humidity will cause damage to instruments and controls, and in any office areas in the larger main pump stations in geographic areas where ambient temperature and humidity requires comfort air conditioning. Ventilation will be provided for all areas not requiring comfort air conditioning or dehumidification and in below ground structures.

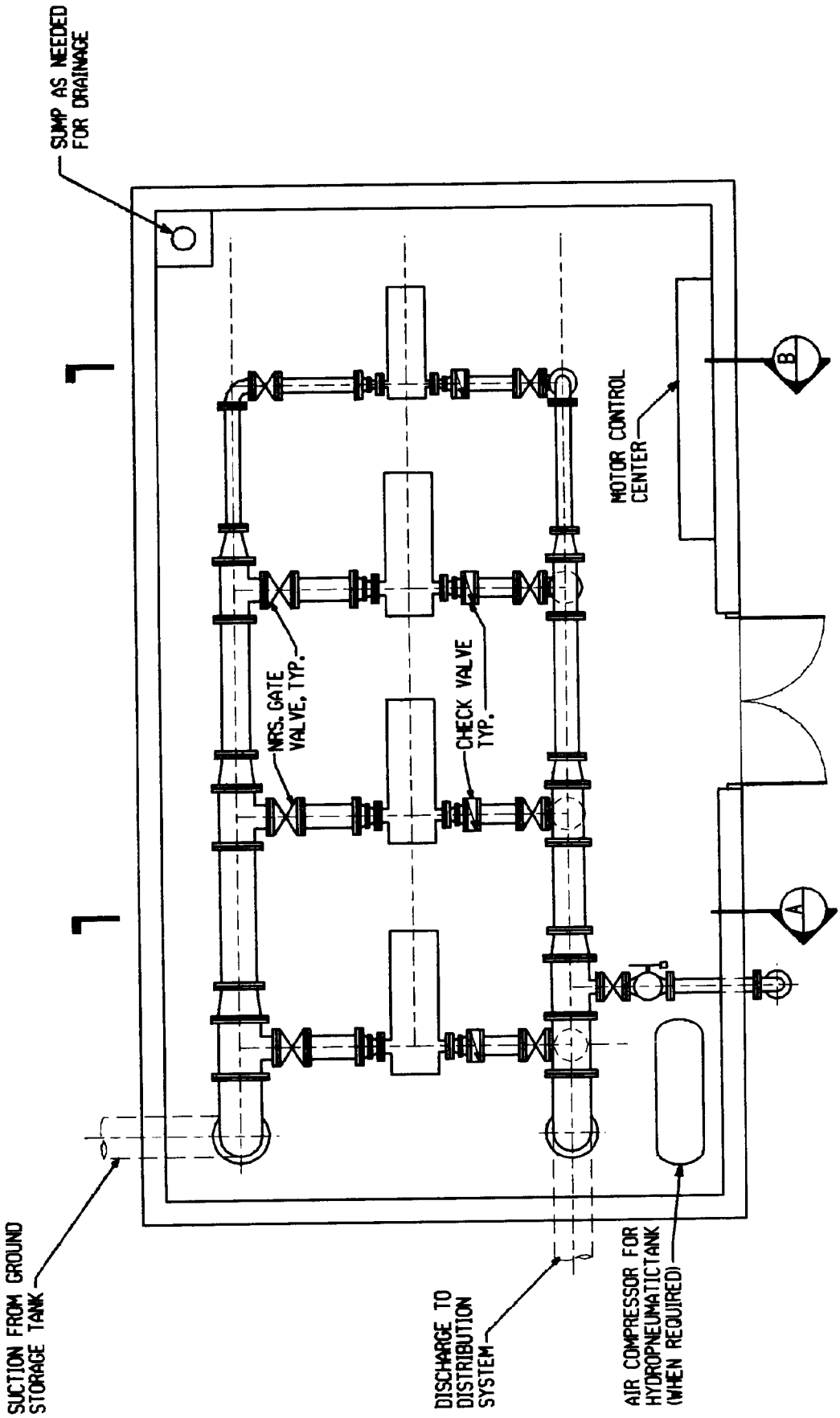
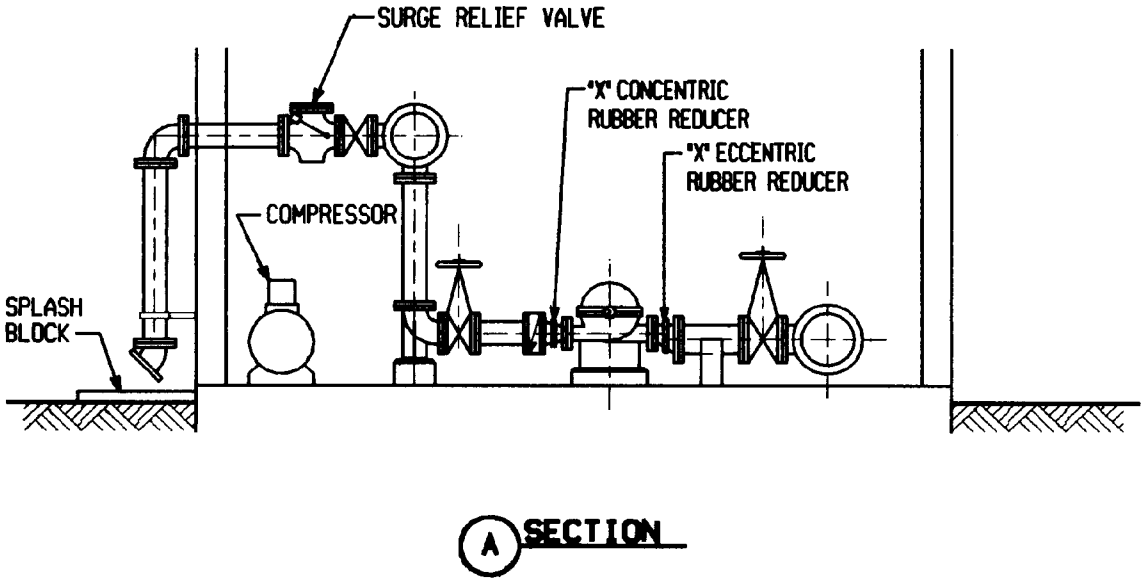
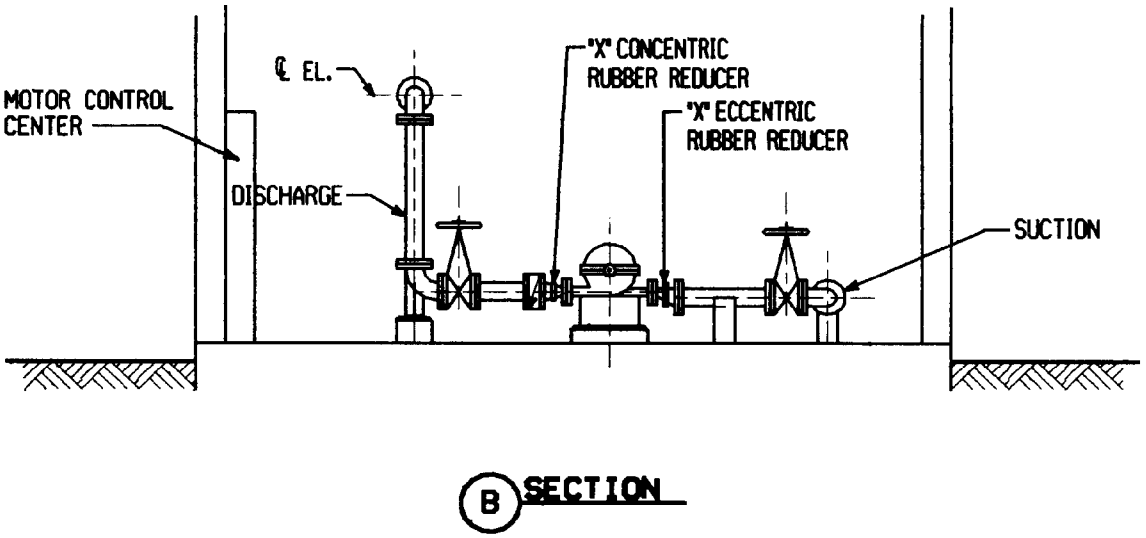


Figure 5–1. Pumping Station Typical Layout





Figures 5–2. Pumping Station Sections